

**Middle School Place-Based Unit Plan For Environmental Concerns
in Carmel, Indiana**

An Honors Thesis (HONR 499)

By

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Abstract

Place-based units are a way to incorporate a student's surrounding environment to what they are learning in the classroom. STEM (Science, Technology, Engineering, and Mathematics) learning is becoming more prevalent in schools as future jobs are demanding these skills. This seven day place-based unit plan for Carmel, Indiana middle school teachers, incorporates STEM learning that consists of laboratory activities, discussion topics, worksheets, and readings for science teachers to help their students recognize issues and possible solutions in their surrounding environment. At the end of the unit students use the knowledge they learned in the classroom to find a new plot for a hazardous waste collection center in Carmel, Indiana. Currently, Carmel, Indiana has one public hazardous waste collection center, but with the great amount of waste that is being generated in each household there is a necessity for another waste site to be built. Students will use ArcGIS online technology in order to create their own GIS (Geographic Information System) map and show understanding of the learning in the classroom.

Acknowledgements

I would like to thank Dr. Josephine M. Shireen Desouza for not only taking the time out of her busy schedule to advise me through this unit plan, but also to provide continuous support with the GIS software. She was encouraging, patient, and very optimistic during this unit plan and the four years serving as my college advisor.

Introduction

Place-based units are a way to incorporate a student's surrounding environment to what they are learning in the classroom. STEM (Science, Technology, Engineering, and Mathematics) learning is becoming more prevalent in schools as jobs are demanding these skills. This place based unit on environmental concerns and possible solutions focuses on the student task of finding a new plot for a hazardous waste collection center in Carmel, Indiana. Carmel, Indiana is a fast growing suburban edge city on the north side of Indianapolis, home to about 86, 000 residents. In 2012, CNN Money Magazine ranked Carmel "#1 Best Place to Live in America". Over the past 20 years this city has become one of much growth as progressive city development continues (About, 2014). Carmel, Indiana currently has one public hazardous waste collection center, but with the great amount of waste that is being generated in each household there is a necessity for another waste site to be built. After becoming familiar with the environmental concerns that are addressed in the unit, students will use the GIS (Geographic Information System) program, ArcGIS online, at the end of the unit in order to find a suitable location for a new hazardous waste center.

Rationale

A place-based lesson plan is designed to teach students about the topic at hand by relating the topic to something that pertains to the area they live in. Place based science is beneficial to student learning because it utilizes, "the process of using the local community and environment as a starting point to teach concepts in language arts, mathematics, social studies, science, and other subjects across the curriculum. Emphasizing hands-on, real-world learning experiences, this approach to education increases academic achievement, helps students develop stronger ties to the community, enhances student's appreciation for the natural world, and creates a heightened commitment to serving as active, contributive citizens. Community vitality and environmental quality are improved through the active engagement of local citizens, community organizations, and environmental resources in the life of the school." (Sobel, 2004).

By researching the Indiana state standards and how they can correlate to the Indiana environment and community, teachers can utilize placed-based science to create a sense of community, knowledge and experiences needed for students to actively participate in the democratic process. The goal of place-based science is to prepare students to "live and work to sustain the cultural and ecological integrity of the places they inhabit." (Woodhouse, 2000). A place-based education addresses a major educational concern of the disconnect between formal education and students' lives, by engaging students in an educational curriculum that allows them to become contributing and competent members of their community and families (Athman, 2004). Environment place-based programs can also improve performance on standardized tests, reduce classroom management problems, and increase

engagement and enthusiasm for learning (Lieberman & Hoody, 1998). This type of education will also strive to create a sense of belonging for students, and pride in their accomplishments throughout their education.

The purpose of this project was to relate the students' surrounding community to what they are learning in the classroom, and make the material more interesting and useful to the student. GIS (Geographic Information System) technology is utilized in this unit plan, to aide in students' development of critical thinking, scientific reasoning, data collection, and technology use in the classroom. A place-based lesson plan is an approach toward teaching that aids in the learning process as students are immersed in their own community while still learning the required material that is mandated by the state. This project will enable students to find connections between their local surroundings and capture their imaginations in the learning process. Through this unit, students will begin to imagine new possibilities for solving the environmental problems that surround them. Students will become more engaged in the learning process, because they are learning about ideas and concepts that pertain to their lives.

With STEM (Science, Technology, Engineering, and Math) fields becoming more prevalent in education, students are required to collect data, make conclusions using methods of inquiry, integrate technology in their learning, and think critically. "Not only can GIS take advantage of data and maps stemming from a variety of disciplines, but its statistical and analytical toolkit draws deeply from decades of research and development in a variety of fields. Therefore, students and educators using GIS in STEM are applying a tool to study phenomena from a wide variety of disciplinary perspectives." (Connecting, 2012) GIS is a tool that allows students to visualize relationships, trends, and patterns by using maps, and it also challenges students to question, interpret data, and visualize conclusions to some of the world's problems. Students using GIS will also gain the advanced skills, problem-solving techniques, decision-making abilities, and in depth reasoning that will help them to secure the occupations that are in demand in the workforce. GIS allows students to research environmental issues by looking at how the land has changed over time; the geographic perspective provided by GIS enables students to analyze the land they live on and make decisions as to how these changes on the land affect their lives. This unit plan allows students to utilize GIS technology by challenging students to find a new location for a hazardous waste site in Carmel, Indiana through the use of the GIS program ArcGIS online (Connecting, 2012).

Schedule Overview

Day	Overview	Homework
1	Prezi Introduction to Natural Resources http://prezi.com/1fzatr55ahx/?utm_campaign=share&utm_medium=copy&rc=ex0share	Write down 2 facts they learned for each paragraph from the article
2	Land Use Activity	None
3-4	MyEnvironment Activity & Presentations	None
5	Antifreeze and Worms Lab Activity	None
6	GIS Work Day	None
7	GIS Work Day	None

Day 1

Overview

This lesson will provide students with basic information about natural resources in their daily lives. It will also introduce the concept of renewable and nonrenewable resources.

Essential Questions

What kinds of natural resources do we use in our lives?

Standards

8.2.7- Recognize that some of Earth's resources are finite and describe how recycling, reducing consumption and the development of alternatives can reduce the rate of their depletion.

Objectives

Students will be able to understand the types and uses of Earth's natural resources by classifying resources into renewable or non-renewable.

Procedures

- Name one item you use every day and describe how you think this item is made. Put this in on a post-it note and put on the board at the end of class. Allow for a few students to share what they wrote down. (10 minutes)
- Show Prezi on Natural Resources. Students write notes during Prezi. (15 minutes)
- "Renewable or Nonrenewable" station game. For this activity the teacher should set up stations with a variety of examples of renewable and nonrenewable resources from Indiana (these could be pictures or actual objects). Each station should only have one picture/object. Students should be placed in pairs, and should then travel to each station together. Number of may stations vary, but 6 - 8 would work well. While at each station, the student must write down in their scientific journal (or a blank sheet of paper) the station number, object/picture name, type of natural resource (renewable or nonrenewable), and an explanation as to why they chose that type of natural resource. (20 minutes)
- Have students read "List of Natural Resources in Indiana" by USA Today (10 minutes)
<http://traveltips.usatoday.com/list-natural-resources-indiana-63394.html>
- Homework: Students should finish reading that article and should answer these three questions using complete sentences:
 1. What are the most important non-renewable resources found in Indiana, and who oversees the drilling and production of these resources?
 2. Is coal renewable or non-renewable? What type of mining contributes to up to 80 percent of the total mining in the state?
 3. Of the thousands of plant and animal species in Indiana, how many are documented as rare, threatened, or endangered? Write down one way our society can strive to prevent future plant and animal species in Indiana from being added to this list.

Resources/Materials

Interactive Science Textbook Pearson Grade 8, Book 3, Indiana

Post It Notes

Prezi on Natural Resources

Assessment/Evaluation

Students will be evaluated from their answers on the station game as well as their reasoning's about what they believe each station represents. Students will be evaluated by the correctness of their answers to the three questions about the article.

Day 2

Overview

This lesson will provide students with basic information about how human activities can affect land and soil.

Essential Questions

What are some positive and negative affects that human activities have on land and soil?

Standards

8.2.6- Identify, explain, and discuss some effects human activities have on the biosphere, such as air, soil, light, noise and water pollution.

8.2.7- Recognize that some of Earth's resources are finite and describe how recycling, reducing consumption and the development of alternatives can reduce the rate of their depletion.

Objectives

Students will be able to understand the types and uses of Earth's natural resources by discussing the ways society uses these natural resources.

Procedures

- Begin lesson with the question, "Why is land important?". Students should respond with answers such as, "Human life needs land to survive., Land and its resources affect our daily lives., Land is needed for us to build things., etc." Continue by asking students, "What are different ways humans use the land?". Student responses should be "For recreation, transportation, our homes, agriculture, buildings, stores, industries, etc." (5-7 minutes)
- Have students sit in pods of 3-4 and allow them to work together on the "Different Types of Land Use activity/worksheet" Teacher should walk around, monitor, ask questions about what they are writing down. (25 minutes)
- Discuss the worksheet together as a class (10 minutes)
- Develop a list as to how we can help to save our environment. Keep this as a running list on a large sheet of paper so students can see it everyday. (10 minutes)

Resources/Materials

Interactive Science Textbook Pearson Grade 8, Book 3, Indiana
Post It Notes

Assessment/Evaluation

Students will be evaluated from their answers on the station game as well as their explanations. Students will be evaluated by their participation.

Different Types of Land Use

Name: _____

Period: _____ Date _____

Type of Land Use	Examples in Indiana (Provide @ least 3 per category)	Impact on the Soil
Road and Train Tracks		
Agriculture		
Residential Rural (Low densities of people, open land) & Urban (Dense populations)	Rural- Urban-	
Urbanization Growth of urban areas caused by people moving into the cities. As cities and towns start to expand, commercial businesses are built, thus replacing rural or natural resources.		

Different Types of Land Use Answer Sheet

Type of Land Use	Examples in Indiana (Provide @ least 3 per category)	Impact on the Land
Road and Train Tracks	US 31 interstate, new roads for neighborhoods, Muncie train tracks	Clears forests, may reduce habitats for wildlife
Agriculture	Farm land, Conservation Forests or Parks	Drains wetlands, clears forests, erosion, barren land, nutrient depletion
Residential Rural (Low densities of people, open land) & Urban (Dense populations)	Rural- farm houses, houses in the country, West Carmel houses with a lot of open land Urban- cities, apartments, condos, people living in downtown Carmel	Clears forests, reduces habitats for wildlife
Urbanization Growth of urban areas caused by people moving into the cities. As cities and towns start to expand, commercial businesses are built, thus replacing rural or natural resources.	People moving into Carmel/ Hamilton County, new factories being built, Lucas Oil Stadium in Indianapolis	Causes environmental harm from wastes and toxic substances from the expanding cities

Day 3

Overview

This lesson will provide students with basic information about the three different types of solid waste disposal. This lesson will also provide students with examples of how they can help to control the solid waste problem. This lesson also discusses the importance of hazardous waste disposal.

Essential Questions

What ways can we help to control the solid waste problems?

What types of concerns should we have about our environment?

Standards

8.2.7- Recognize that some of Earth's resources are finite and describe how recycling, reducing consumption and the development of alternatives can reduce the rate of their depletion.

Objectives

Students will be able to understand the types of waste disposals that they find in Carmel, Indiana. Students will read about these types of waste disposals in their book and answer the notes sheets. Students will also begin to learn about their environment through their research on the MyEnvironment website.

Procedures

- Begin class with fill in notes about waste disposal and recycling notes, students should use their textbook answer these notes. (20 minutes)
- Divide students into groups of 4-5 and assign each group a category from the site <http://www.epa.gov/myenvironment/>
- On this site, students should type in the school's address into the search bar and click "go", then they will be prompted to a screen with many different categories about their environment
- Categories include: MyAir, MyWater, MyEnergy, and MyHealth
- Each group will be assigned a category to research. For their research, they must make a half sized poster board to present their findings. Color must be used, and students must work with their partner in order to make the poster and research their category. Students must answer the 5 provided questions for their corresponding group. Time will be given in the next class day to make posters, and only a half computer lab day will be given today and then the next day. (Remaining class time).
- Each group must answer the following questions in their poster/presentation for their topic:
- **MyAir Group Questions-** What is radon exposure, and how does it impact society? What is the radon zone chart? What zone is Carmel, Indiana in and how does that impact society? What is the ultraviolet index, and what index does Carmel, Indiana fit in? What is the current air quality index for Carmel, Indiana, and what does this mean for our community?
- **MyWater Group Questions-** Name the two local drinking water providers in Carmel, Indiana that have the greatest amounts of populations served, and find the locations of these water providers. Draw a map on your poster pinpointing these two providers. Why are there many drinking water providers for Carmel, Indiana, and what is their primary water source type? Name a company that has recently been issued a permit to discharge waste water into Indiana rivers. Why do companies have to receive a

permit to discharge waste water? What would happen if no permits were needed? According to the Site-specific Targeted Monitoring Results (Causes of Impairment Indiana Rivers and Streams 2010) what is the cause of impairment with the most miles threatened or impaired? How can we solve this issue? Search "Cool Creek Basin" under the Water Quality Assessment section and find the status of this river. What is causing the status of this river?

- **MyEnergy Group Questions-** What is the highest energy consumption material in Indiana in 2010, and what percentage is this material? What is the purpose of Home Energy Saver? How can homeowners use this tool to reduce the energy used in their homes? Where are natural gas energy facilities located in Carmel, Indiana? What green power products are available from energy providers in Indiana? What types of energy are used with these different programs? Why is green energy important?
- **MyHealth Group Questions-** What are the cancer risk estimates for Hamilton County, Indiana in 2005? What category has the largest percent breakdown and what types of toxic chemicals are in this category? How can we reduce these toxic pollutants from our environment? What pollutant contributes to the greatest percentage of cancer risk, and what is this percentage? What is one of the leading causes of neonatal mortality? What are the rate comparisons of 2004 low birth weight in Hamilton County, Indiana, and National? What race/ethnicity has a higher risk of infants born with low birth weight?

Resources/Materials

Computer Lab Access

Poster boards, scissors, glue, old magazines, markers, construction paper, etc.

<http://www.epa.gov/myenvironment/>

Assessment/Evaluation

Students will be evaluated from their poster presentations and work on their research topic. Rubric for their poster presentations is in Day 4 lesson plan.

Name:

Waste Disposal and Recycling Notes

Types of solid waste disposal

1. _____ is the burning of solid waste. The burning facilities are called_____.

Pros:

Cons:

2. _____ are for the disposal of waste in open holes in the ground. They hold municipal solid waste, construction debris, and some industrial and agricultural waste.

Pros:

Cons:

3. _____ is the process of reclaiming raw materials and reusing them to create new products

3 R's of recycling include:

- Reduce_____
- Reuse_____
- Recycle_____

How are Hazardous Wastes SAFELY Disposed of?

- _____ are any material that can be harmful to human health or the environment if it is not properly disposed of.

- Types of hazardous wastes can be explosive, radioactive, corrosive, or toxic waste.
- Everyday hazardous wastes include_____.
- Short term exposure to hazardous wastes can cause_____.
- Long term exposure to hazardous wastes can cause_____.
- Disposal methods include:
- Another disposal site includes **hazardous waste disposal facilities** where people can dump their wastes.

Day 4

Overview

This lesson will provide students time to work on their MyEnvironment poster with their partner and also allow for students to present their findings.

Essential Questions

What are some concerns we should have regarding our environment?

Standards

8.2.7- Recognize that some of Earth's resources are finite and describe how recycling, reducing consumption and the development of alternatives can reduce the rate of their depletion.

Resources/Materials

Notebook paper

<http://www.epa.gov/myenvironment/>

Engagement

- Show short video clip on human impact on earth.
<https://www.youtube.com/watch?v=3zyizEz9XUs>

Exploration

- Allow for half the class period for students to finish their posters and write ups on their category from the previous day. Students are exploring to find the answers to what concerns they should have in our environment.
- **Objectives**
 - Students will be able to understand the issues and concerns they face in their own environment.
 - Students will be able to determine the cleanliness of their community and

Explanation

- The last half of class should be dedicated to the students each presenting their findings. There may be overlap with groups having the same category. That is perfectly fine. Just have those groups present together. While other groups are presenting, the audience groups must jot down two facts per group they learned from the presentation of their peers on a sheet of notebook paper. Students must also answer the question "How does this impact me?" and write in complete sentences how the information from each group impacts their community and lives.

Elaboration

At the end of the class period students should discuss how the information they learned impacted them.

- Exit pass: Students should write on a post-it note one of their answers to the question, "How does this impact me?" and place it on the board. Teacher should collect their notebook papers.
- Homework: Evaluate each of your group members using the provided rubric.

Evaluation

Students will be evaluated by their participation and active engagement during the presentations using the My Environment Rubric.

My Environment Rubric

Name: _____

Group Topic:	1 point	3 points	5 points	Total Score
Answered Provided Questions for Group and Presented Findings	Answered 2 or less provided questions thoroughly and correctly	Answered 3-4 provided questions thoroughly and correctly	Answered all 5 provided questions thoroughly and correctly	
Presentation (Filled out notebook sheet answering the question, "How does this impact me?" & wrote down 2 facts per group)	Did not write down facts or answer, "How does this impact me?" for each group participation	Wrote down half the work of the 2 facts and answering, "How does this impact me?" for each group presentation	Wrote down 2 facts & answered, "How does this impact me?" for each group presentation	
Participation Evaluation	No credible participation in research or presentation	Somewhat participated during research and presentation, but did not give full effort	Actively participated during research and presentation	
Poster Presentation Creativity	Unorganized, no color, no pictures, lack of effort	Some color used, somewhat organized, some pictures	Interesting, neat, Colorful, included pictures and creative	

Total Score: _____/20

Comments:

Day 5

Overview

This lesson will provide students with hands on experience with the effect that hazardous waste has on life forms by experimenting with antifreeze solution and worms and the interaction that occurs with various amounts of antifreeze solution. This lesson helps students to experience how toxic chemicals harm the environment.

Essential Questions

How do toxic substances affect our environment?

Standards

8.2.7- Recognize that some of Earth's resources are finite and describe how recycling, reducing consumption and the development of alternatives can reduce the rate of their depletion.

Objectives

Students will experiment with automobile antifreeze to see the interaction that toxic substances have with our environment.

Students will compare different concentrations of antifreeze and their affect on earthworms.

Students will make connections about how toxic substances can harm their community and environment.

Procedures

- Fill each of the three 1-liter containers with 16 oz of water and clearly mark the 16 oz level on the side. Pour out the water and shake the containers dry.
- Label containers either Low (6 percent), Medium (12 percent), or High (24 percent) ethylene glycol. For the low-dose solution pour 1 oz of antifreeze in the container and fill up to the 16-oz mark with water. For the medium-dose solution pour 2 oz of antifreeze in its container and fill up to the 16 oz mark with water. For the high-dose solution, pour 4 oz of antifreeze in its container and fill up to the 16-oz mark with water. Shake or stir well.
- Divide class into teams of two to four students each. Provide each team with 5 plastic cups, tape, marker, and the sheets on the next page
- Have students label their containers, and demonstrate the steps they need to take that are on their handout.
- After lab, discuss with students what they discovered.

Resources/Materials

- Small plastic cups (5 per group)
- Three empty one-liter plastic soft drink containers with caps
- Refrigerated tap water
- Automobile antifreeze (ethylene glycol)
- Live, fresh-water black (hair) worms, sold as fish food in pet stores (50 or more worms per group)
- 16-ounce measuring cup
- 1-ounce measuring cup (used to measure doses of cough syrup)
- Plastic wrap
- Tape and markers
- Copies of the Student Handout, Black (Hair) Worm Experiment (1 per group)
- Copies of the Student Worksheet, Black (Hair) Worm Experiment (5 per group)

Lab modified from <http://www.epa.gov/superfund/students/class-act/haz-ed/act05.htm>

Assessment/Evaluation

Students will be evaluated from their answers after the lab, as well as their participation in the lab experiment.

Worm Experiment Directions

Your teacher will provide you with:

- Five small, clean plastic cups
- Live, fresh-water black worms (hair worms)
- Tape and markers
- 5 copies of a student worksheet for recording your observations
- Antifreeze (ethylene glycol) solutions of 6 percent, 12 percent, 24 percent
- Refrigerated tap water

Step 1

Label cups as “low dose”, “medium dose”, “high dose”, “control pre-test”, and “control post-test”

Step 2

Add just enough cold tap water to barely cover the bottom of the container “control pre-test” and place about 10 worms in the water. (DO NOT SUBMERGE THE WORMS: THEY WILL DIE). Observe the worms for 4 minutes and water for any changes in behavior. Record the results on the appropriate line of the worksheet. Set the “control pre-test” cup aside, but don’t throw it away.

Step 3

After recording the behavior of the “control pre-test” group, conduct similar observations of different worms (about 10 per cup) in order from “low dose” to “high dose”. Use appropriate antifreeze mixture prepared by your teacher for each dose level. Use the worksheet to record the behavior of each group of worms after 4 minutes.

Step 4

After you have observed the results from all 3 solutions, repeat the control test by again adding barely enough cold water to cover the bottom of the cup labeled “control post-test” and place about 10 worms in the water. Observe for 4 minutes for any behavioral changes. Record the results in the worksheet.

Step 5

At the end of the experiment observe the total time and take one last look at the worm behavior in all of the cups.

Worm Experiment

Name:

Score:_____/24

Table (1 point each box)

Test	Behavior after 4 minutes	Behavior at end of experiment	Total time from start of experiment
Control Pre-test			
Low Dose			
Medium Dose			
High Dose			
Control Post-test			

1. Were there obvious behavioral differences between the control groups and the antifreeze-exposed groups? If yes, describe. (1 point)

2. Did the concentration of antifreeze in the water influence the degree of behavioral change? If yes, describe. (1 point)

3. Was there a safe level of exposure? In other words, was there an antifreeze concentration that did not appear to cause an effect over the 4-minute observation period? Could you tell? (2 points)

4. Does the acute (rapid, short-term) effect of antifreeze on the worms indicate anything about what the long-term or chronic (lifetime) effects might be? (1 point)

5. Is behavior the only possible measure of effect? Why or why not? (1 point)

6. Can you determine from this experiment the cause of death of the worms? (1 point)

7. Is it possible that while antifreeze affects the health of the worms, it has no effect on humans? (Is it also possible that antifreeze has no effect on worms for adversely affects human health?) If yes, describe. (2 point)

Day 6

Overview

This lesson will allow students to get some experience using GIS and use technology in the classroom. It will also allow students to think critically about their environment and where a hazardous waste site should be placed. In this lesson students will begin a worksheet and research on Carmel, Indiana hazardous waste sites. Students will then begin forming map layers using ArcGIS Online.

Essential Questions

How can GIS help to solve some of the world's problems?

What ways can GIS technology help society find answers to our environmental questions?

Standards

8.2.7- Recognize that some of Earth's resources are finite and describe how recycling, reducing consumption and the development of alternatives can reduce the rate of their depletion.

Objectives

Students will be able to understand the use of hazardous waste sites.

Students will critically decide where they believe a hazardous waste site should be placed.

Students will use GIS technology to determine a new site for a hazardous waste site.

Procedures

- Students should read and work their Hazardous Waste Site GIS Activity Worksheet with group members. Groups should include 3-4 students.
- Review handout about how to set up a GIS map, and demonstrate skills on overhead projector.
- Allow students to work in their groups in order to develop their map as to where they believe a hazardous waste site should be placed.
- Students should answer the questions on their sheet after they design their GIS map as well as include a GIS map and Legend to turn in.
- Students should complete "Adding Map Layers" and "Legend" portions of their maps using the GIS Instructions Sheet.

Resources/Materials

Computer Lab/ laptops

GIS handout

Assessment/Evaluation

Students will be evaluated from their answers their GIS worksheet. Their explanations and reasoning will provide information about their thought process while deciding on the best location for a hazardous waste site.

Day 7

Overview

This lesson will allow students to get some experience using GIS and use technology in the classroom. It will also allow students to think critically about their environment and where a hazardous waste site should be placed. In this lesson students will begin a worksheet and research on Carmel, Indiana hazardous waste sites. Students will then begin forming map layers using ArcGIS Online.

Essential Questions

How can GIS help to solve some of the world's problems?

What ways can GIS technology help society find answers to our environmental questions?

Standards

8.2.7- Recognize that some of Earth's resources are finite and describe how recycling, reducing consumption and the development of alternatives can reduce the rate of their depletion.

Objectives

Students will be able to understand the use of hazardous waste sites.

Students will critically decide where they believe a hazardous waste site should be placed.

Students will use GIS technology to determine a new site for a hazardous waste site.

Procedures

- Review handout about how to set up a GIS map.
- Allow students to work in their groups in order to develop their map as to where they believe a hazardous waste site should be placed.
- Students should answer the questions on their sheet after they design their GIS map as well as include a GIS map and Legend to turn in.
- Students should finish the "Adding Boundaries", "Making Layers Transparent", "Adding Map Notes", and "Buffers" portions on their GIS Instructions.

Resources/Materials

Computer Lab/ laptops

GIS handout

Assessment/Evaluation

Students will be evaluated from their answers their GIS worksheet. Their explanations and reasoning will provide information about their thought process while deciding on the best location for a hazardous waste site.

Hazardous Waste Site GIS Activity

1. What is a hazardous waste site? How do they benefit society?
2. With your group members, research the location of current hazardous waste sites in Hamilton County, Indiana. Where is a hazardous waste site located? Write down (in complete sentences) a few reasons as to why you think the hazardous waste site is located there. (Look at population density, school, hospital, and park locations, nearby rivers, etc.)
3. It is your job to pick a new area in Hamilton County, Indiana to place a hazardous waste site. For this location you must use ArcGIS online mapping software in order to pinpoint your new location on the map. Please include your reasoning as to why you believe a new hazardous waste site should be placed here. You must include buffers in your map around schools, current hazardous waste sites, parks, and hospitals. You will also need to create a screen shot of your work as well as a screen shot of your map legend.

GIS Instructions

Log into ArcGIS online. Enter your username and password.
Create a new map by clicking on “map” (left hand side).
Type in Carmel, Indiana on the “Find address or place” scroll bar on the right
Then click “basemap” and click “topographic”

Adding Map Layers

Next add a layer on to map. Click “add”, then click “search for layers”, then type in “demographics” in the “find category” and for the “in category” click the arrow down to find “ArcGIS online” and click on that. You should then see different results for your search. Choose the best fitting result (Choose “USA population density”) by clicking “add”, and then click “done adding layers”. Your map should show the demographics now. (See Figure 1 for an example of the Carmel demographics map)

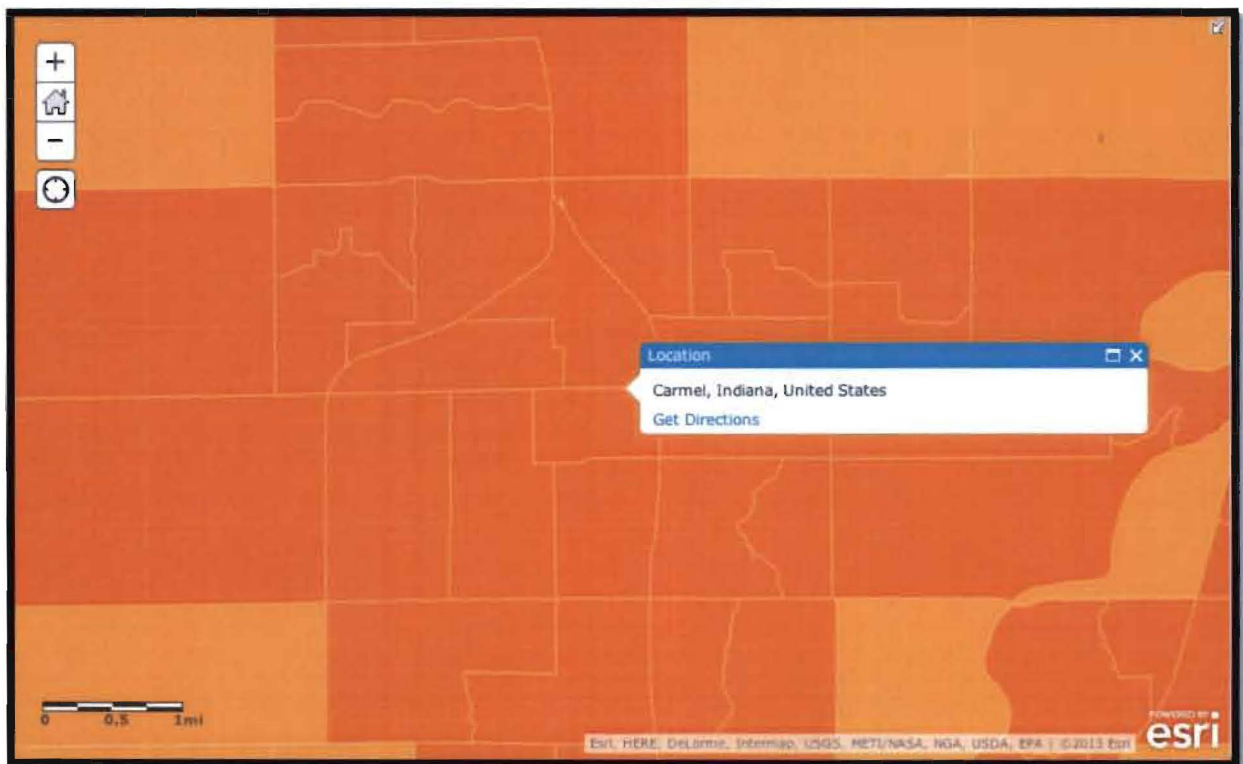


Figure 1: Demographics Map

Perform these same steps only this time instead of “demographics” you should type in “Hazardous Waste Sites”. I would recommend choosing the map by Esri. Click “add” and then click “done adding layers”. Repeat this process by adding in the layers “Indiana schools”, “Indiana hospitals”, and “Indiana parks”, and “World Imagery”.

Legend

Click “legend” in the left hand corner. You should now see what each of your points on the map represents. (See Figure 2 for location of an example legend in ArcGIS software). You should take a screen shot of the legend and place it next to your final map of your new hazardous waste site.

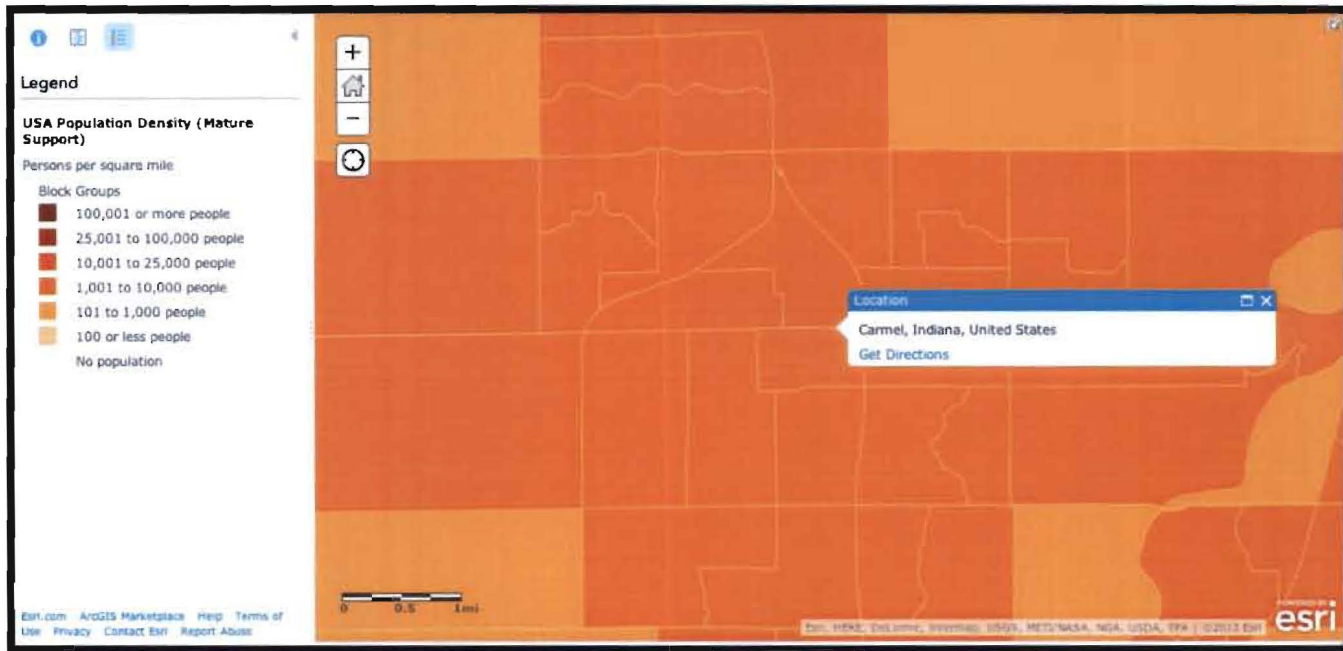


Figure 2: Legend Example for Demographics Map

Adding Boundaries

You must now create a boundary around Carmel, Indiana. In order to do this, you should click on "Content", then uncheck "World Imagery" (leaving everything else checked), then you should click on "add", "add map notes", then click on "rectangle", drag this rectangle around Carmel, Indiana. You should then see a boundary line that has been created. Label this boundary "Carmel, Indiana Boundary", and write a short description in the description box. (See Figure 3 for a boundary example).

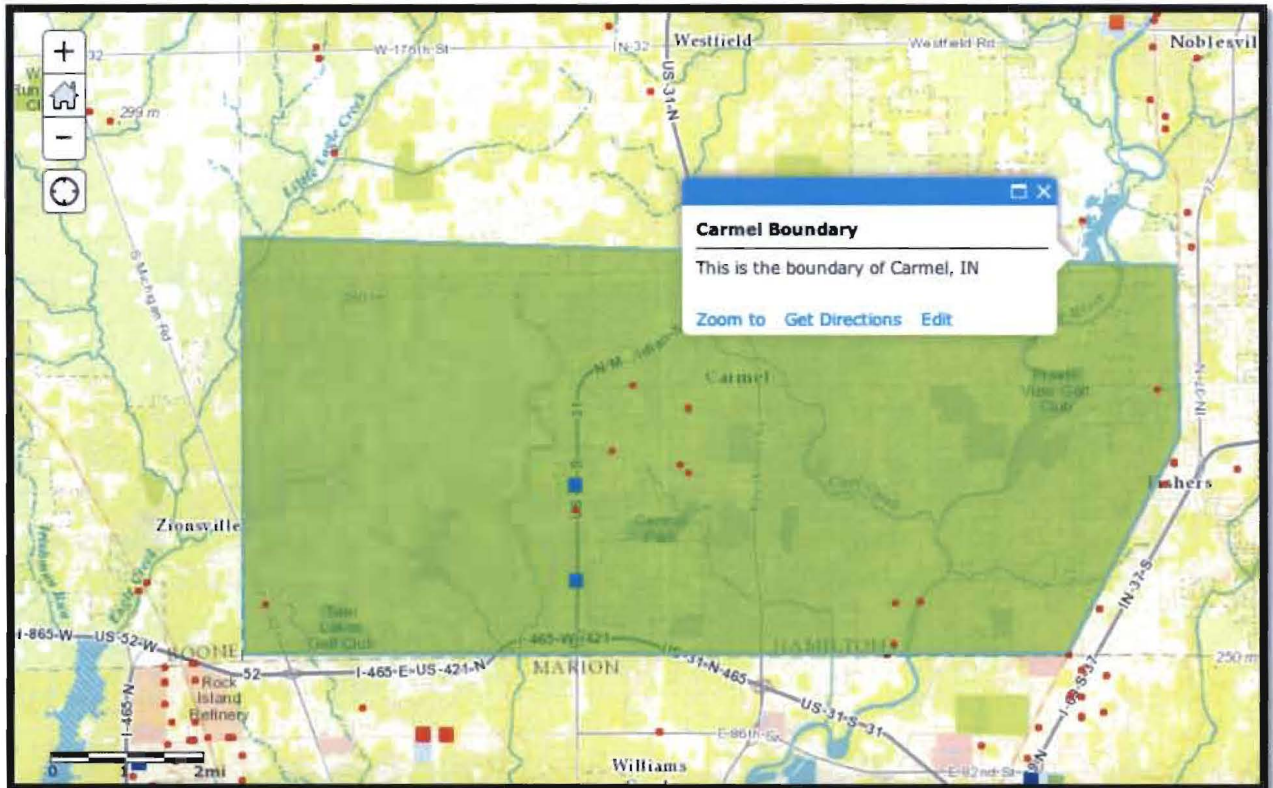


Figure 3: Carmel, Indiana Boundary Example

Making Layers Transparent

Click on "content" in the upper left hand corner. Then uncheck the map layer that you do not want to see on your map. Another way to make a later transparent is to click on the arrow down button next to each layer name, then click "transparency" and you can change the percentage of transparency that you would like to see on your map for the layer.

Adding Map Notes (Pinpointing)

Click “add, then click “add map notes” and create a name for map notes, click “stock pin” and place the pin where you believe a new hazardous waste site should be placed. Make sure that this pinpoint is on a street that people can access, and also that there are currently no other buildings that are located at your pinpoint. In order to see buildings, streets, and vegetation you should uncheck “USA Population Density” in the “content” section. You will then need to create a buffer to ensure that your new site is not close to any schools, hospitals, or parks. You must create a buffer for each of the schools, hospitals, and parks in order to ensure that your new site does not fall into one of these places. For an example of what a pinpoint looks like, see Figure 4. You should see that the pinpoint is green in color.

Buffers

Adding buffers around each of the existing hazardous waste sites is necessary in order to figure out where the new waste site should be placed. In order to add a buffer, you should place a point on the map using “map notes”, then click the arrow down button next to the map note in the “content” section, then on the menu click “perform analysis”, then click “use proximity”, click “create buffers”, type in the distance of the buffer you would like to have (use 0.1 miles), then click “run analysis”. Your buffer should be placed around your pin. You should create a buffer around each school, hospital, park, and the current hazardous waste sites. Now check to ensure that no hospitals, parks, or schools are located within this buffer. If these are located inside your buffer, then you must choose a new point for your hazardous waste site location. For an example of what a buffer looks like see Figure 4. You should see that the buffer is blue in this example.

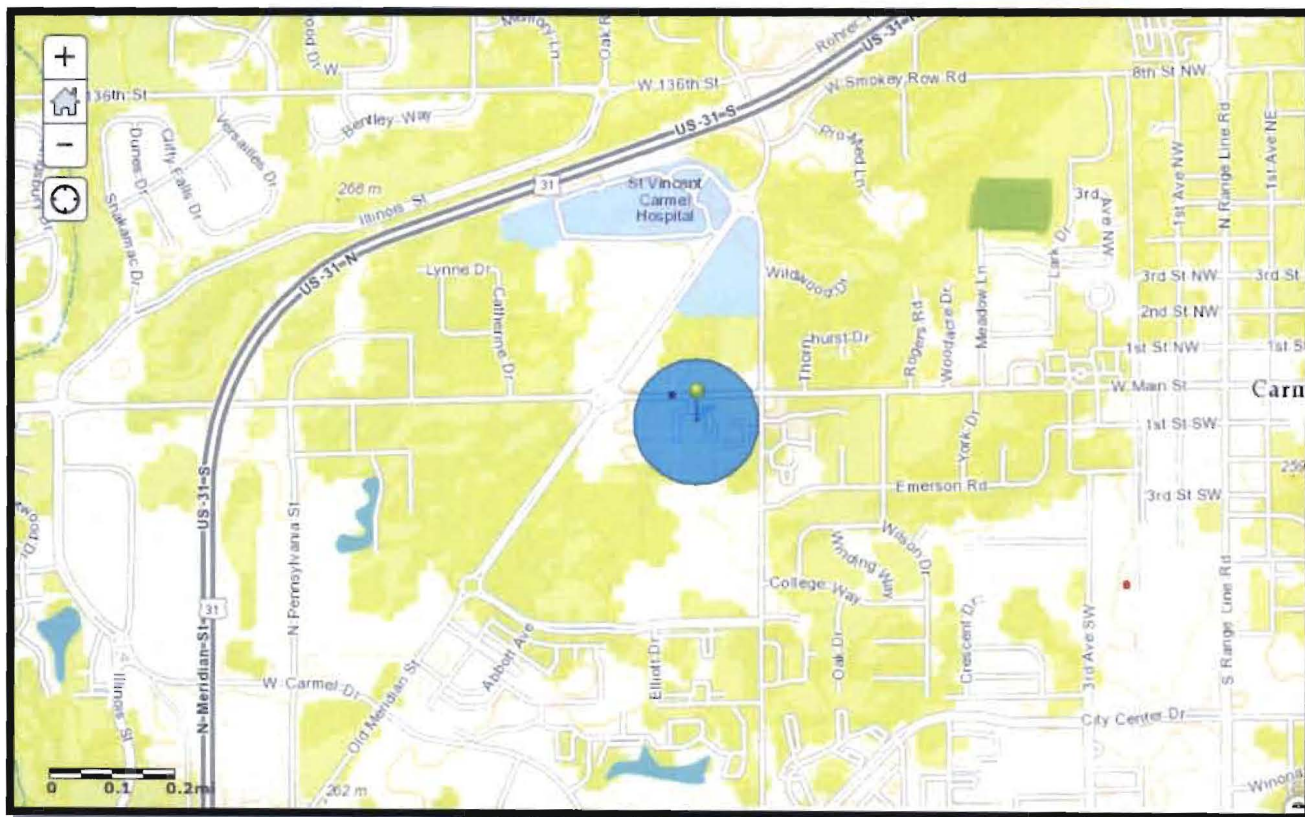


Figure 4: Pinpoint and Buffer Example

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